Certification of Levee Systems for the National Flood Insurance Program

Michael Deering
Chief of Water Resource Systems Division
Hydrologic Engineering Center
Davis, CA

Corps of Engineers
IWR-HEC

Levee Certification Topics

- Definitions
- Roles and Responsibilities
- Flood Damage Assessment Policies
- Certification Guidance
- ETL Schedule
- Certification Process
- Systems Approach
- Partial Certification
- Validity Period
- Technical Criteria
- Authorities

Corps of Engineers

IWR-HEC

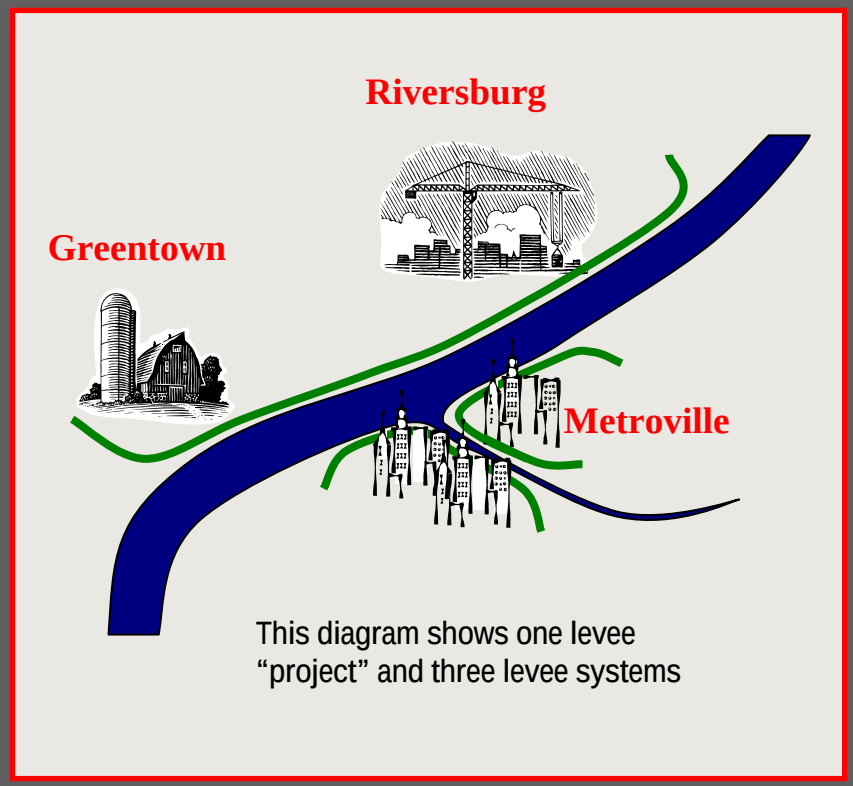
Definitions*

- Levee System
- Accreditation
- Certification
- Deterministic Analysis
- Probabilistic Analysis
- Assurance or CNP

* Slide title with red first letter is a definition slide

Levee System

- A levee system is inclusive of all components that are interconnected and necessary to insure protection of the associated floodplain – levee/floodwall sections, closure structures, pumping stations, culverts, interior drainage works, and system operation and maintenance



Certified Levee System

A levee system that meets and continues to meet minimum design, operation, and maintenance standards as specified in 44 CFR 65.10. The design criteria and structural requirements outlined in paragraphs (b)(1) through (7) must be *certified* by a registered professional engineer or a federal agency responsible for levee design.

Corps of Engineers
IWR-HEC

Accredited Levee System

A levee that the Federal Emergency Management Agency has shown on the Flood Insurance Rate Map as providing protection from the 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by Section 65.10 of the National Flood Insurance Program regulations.

Corps of Engineers
IWR-HEC

Roles and Responsibilities

- Accreditation – FEMA
- Certification - registered professional engineer or a federal agency responsible for levee design

Deterministic Analysis

- A technical analysis approach that is accomplished using single values for key variables.
- e.g. expected flow only in computation

Probabilistic Analysis

- A technical analysis approach that uses a probability distribution rather than a single value for key variables, producing a result that captures and describes uncertainty.
- e.g. expected flow including a range of possible flows in computation

Flood Damage Assessment Policies

Risk-Based Analysis

- Objective: Improve decision making and confidence by quantifying, using, and disclosing risk and uncertainty in key data and parameters.

- Policy: All flood damage reduction studies will adopt risk analysis……
  - ER 1105-2-100 "Guidance for Conducting Civil Works Planning Studies"
  - ER 1105-2-101 "Risked-Based Analysis for Evaluation of Hydrology/Hydraulics, Geotechnical Stability, and Economics in Flood Damage Reduction Studies", dated 1 March 1996
  - EM 1110-2-1619 "Risk-Based Analysis for Flood Damage Reduction Studies", dated 1 August 1996

Risk Analysis Outputs

- Economics
  - Expected Annual Damages (EAD)
- Performance
  - Annual Exceedance Probability (AEP)
  - Conditional Non-Exceedance Probability (CNP)

Conditional Non-exceedance Probability (CNP)

- CNP is the probability that a specified event will be contained by project. For levees, includes both the chance of capacity exceedance as well as the chance of failure at lesser stages.

- CNP is computed by determining the expected exceedances/ failures for event for target elevation, top of levee, or conversely, required elevation for base event and specified CNP.

USACE Levee Certification Guidance

- In 1997, USACE issued an internal levee certification policy
  - Discussed and agreed upon with FEMA
  - Supplements 44 CFR 65.10
  - Requires the application of its risk analysis policy to levee certification

- In 2006, USACE issued updated guidance
  - Risk analysis will be applied to H&H
  - No grandfathering, no exemptions.
  - Will extend to include structural/geotechnical and operational aspects
  - Full and complete engineering analysis with field inspection.
  - Document findings, certification to be signed by PE, Chief of Engineering Division.

Levee System Certification Engineering Technical Letter (ETL)

Draft ETL 1110-2-570, June 2007

Purpose ...to provide a consolidated document that will guide USACE procedures for levee/floodwall systems certification determinations in support of National Flood Insurance Program (NFIP) as administered by the Federal Emergency Management Agency (FEMA).

Corps of Engineers

IWR-HEC

ETL Schedule

- Draft ETL to Principals Review Team (PRT) - 6 April
- Draft ETL to HQ for Staffing - 15 June
- Draft ETL to Independent Technical Review (ITR) - 15 Aug
- Final Release to Field - 30 Sept*

* highly dependent on PRT and ITR

Systems Approach

- Focus is upon the levee system that is associated with a given separable floodplain.
- Levee and floodwall sections, closure structures, pumping stations, culverts, interior drainage works, and system operation and maintenance
- No PARTIAL certifications

USACE Certification Process

- Request is made
- Determine authority
- Determine funding mechanism
- Coordinate SOW
- Perform technical analysis
- Complete documentation
- Perform ITR
- Coordinate findings
- Report findings – Issue Letter (or not)

Validity Period

- 10 years shall be the agency maximum period of validity
- Consistent with the cycle of inspection and assessment provisions
- Certification may be reviewed any time before the maximum period of validity

USACE Levee System Certification

- Data Collection
- Combined Technical Analysis
- H&H Probabilistic
- All others Deterministic
- Other Disciplines as Methods Mature

Corps of Engineers
IWR-HEC

Review Available Information

- Design memorandums, computations, as-built drawings
- Subsurface information; foundation material characteristics,
- Annual and periodic inspection reports,
- Recent surveys, geospatial information, levee geometry,
- Levee zoning, levee materials, construction methods, construction records,
- Performance history, any flood performance records,
- Operation and Maintenance Manual
- Repairs or upgrades made to the levee system.
- Current river velocities, wave properties, or overtopping potential considered.

Certification Site Visit

- Seepage controls are functioning properly,
- Woody growth, erosion, scour, rodent activity, are controlled.
- No abandoned or deteriorated conduits exist in the levee,
- No cracks, roots, or other defects exist.
- Existence of adequate levee cover vegetation,
- Existence of adequate riprap,
- Adjacent construction activities do not affect the structural integrity of levee.

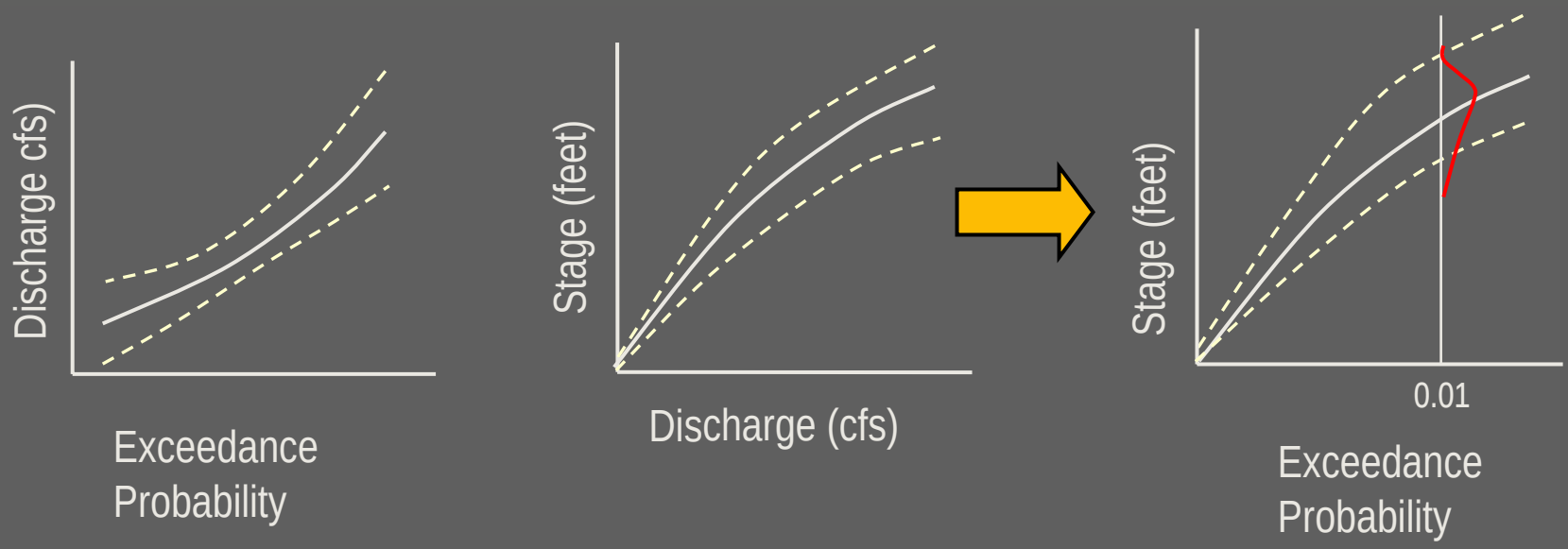
Probabilistic H&H Analysis

- Discharge vs. Frequency with Uncertainty
- Stage vs. Discharge with Uncertainty
- Surge, Wind Wave and Wave Period with Uncertainty

Corps of Engineers

IWR-HEC

Stage - Probability Derivation

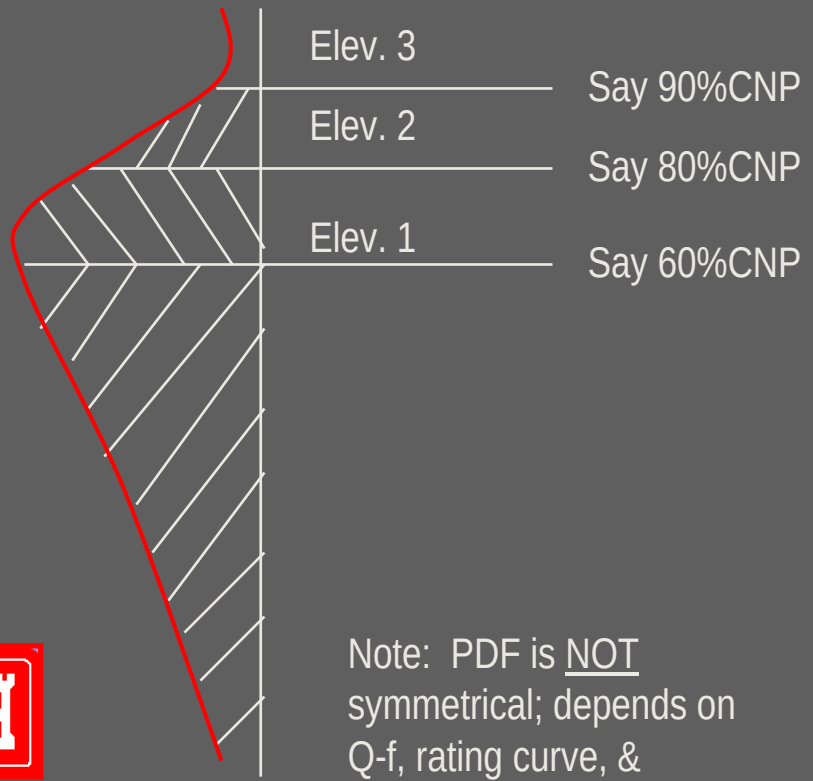


Criteria – CNP > 90% for 0.01 event

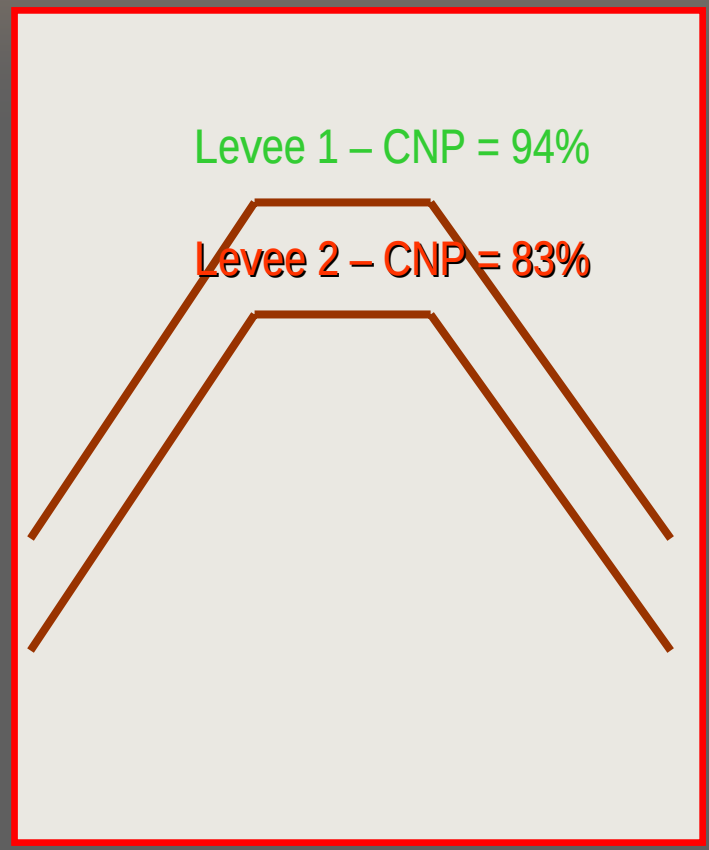
Corps of Engineers
IWR-HEC

CNP Concepts

Elevation PDF for base flood event; e.g. 0.01 exceedance event.

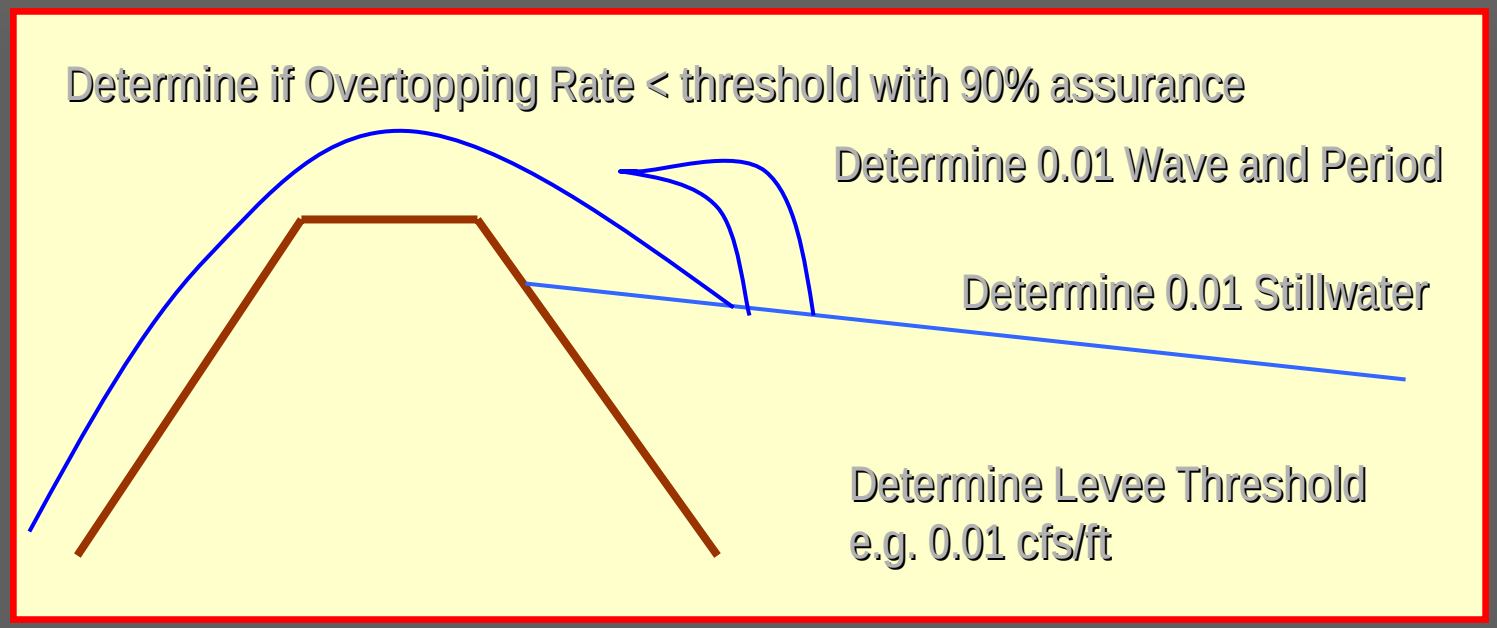


Note: PDF is NOT symmetrical; depends on Q-f, rating curve, & failure prob. Curve.



Corps of Engineers
IWR-HEC

Wind Wave and Overtopping



Coastal and Large Lake Environments

Corps of Engineers
IWR-HEC

Geotechnical Analysis

➔Levee certification based on deterministic analyses and geotechnical judgment.

- ➔Overtopping
- ➔Slope stability
- ➔Underseepage
- ➔Through-seepage
- ➔Surface erosion
- ➔Wave attack
- ➔Flood duration
- ➔Seismic Stability

Identify Potential Modes of Failure Using EM 1110-2-1913, Design and Construction of Levees,"

Other Deterministic Analyses

- Structural
- Mechanical Electrical
- Interior Drainage
  - Local Sources
  - Wave Overtopping

Corps of Engineers
IWR-HEC

Authorities and Programs

- Committing to certify USACE owned/operated/maintained levees currently shown on a FIRM using project O&M funds. Schedule to be determined.

At request of non-Federal sponsor -

- Non-Federal operated/maintained levees in ICW Program
  - Funding - ICW Program, if available
  - Funding – Reimbursed through Economy Act or Support for Others agreement
- Non-Federal in RIP
  - No RIP funding available for levee certification determinations.
  - Funding – Reimbursed through Economy Act or Support for Others agreement

Corps of Engineers

IWR-HEC

CECW-P/CECW-E Memorandum, “Authority and Funding Guidance for USACE Levee Certification Activities”, 15 August, 2006

Authorities and Programs

- Other Federal Levees - at the request of the Federal agency
  - Funding received from requesting Federal agency through Economy Act
- Cannot do determinations for non-Federal levees not in a USACE program (private, state, local built, owned, operated), unless part of a larger cost-shared project
  - Funding – project appropriated funds
- USACE projects in study, design/or construction – Requested by non-Federal sponsor and agreed to be part of the overall project costs
- Cannot initiate a cost-shared study or project exclusively for levee certification

CECW-P/CECW-E Memorandum, "Authority and Funding Guidance for USACE Levee Certification Activities", 15 August, 2006

Authorities and Programs

For any project, using Flood Plain Management Services (FPMS)

- Can provide support for levee certification determinations for others to certify under
- Support activities can include – data collection, mapping, H&H analysis, geotechnical investigations, etc.
- 100% Federally funded, if available
- Can accept voluntary contributions from state or local government to expand scope
- Cannot certify a levee under this program.

QUESTIONS ?

Corps of Engineers

IWR-HEC